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THE BLANKETFLOWER MOTH, SCHINIA MASONI: A POSSIBLE INDICATOR SPECIES FOR LANDSCAPE STRUCTURE AND ECOLOGICAL INTEGRITY OF PONDEROSA PINE WOODLANDS IN THE COLORADO FRONT RANGE

Interim Performance Report

Prepared for
Joint Venture Agreement No. 02-JV-11221611-190

"The Blanketflower Moth, *Schinia masoni*: A Possible Indicator Species for Landscape Structure and Ecological Integrity of Ponderosa Pine Woodlands in the Colorado Front Range"

between the
USDA Forest Service Rocky Mountain Research Station
Research Work Unit Number 4653
and
Conservation and Natural Resource Management Consulting

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Summary

This interim report summarizes the research conducted during July and August, 2002, under a Joint Venture Agreement. All goals identified in the research work plan were successfully met. Ten burn sites in the Colorado Front Range were visited, ranging in age from one to thirteen years since the fire. At four sites, the abundance of *Gaillardia aristata*, Blanketflower, and *Schinia masoni* moth larvae were measured in the burned area and in equivalent unburned habitat nearby. Analysis of the data clearly demonstrates that Blanketflower populations increase dramatically after a fire. These data also show that *S. masoni*, a generally rare heliothidine flower moth (Byers 1989) can be abundant in the dense Blanketflower populations that develop within two years after a fire. Blanketflower abundance declines dramatically within thirteen years following a fire, but moth populations persist at levels that may allow them to colonize newly-burned areas nearby. Because of its clear ecological dependence on fire, and a geographic range limited to the northern Colorado Front Range, it is proposed that *Schinia masoni* could appropriately be called the "Colorado Firemoth." The main hypothesis of this study, that *S. masoni* is a sensitive indicator of large-scale landscape patterning (specifically the spatial heterogeneity and area of early successional habitat created by fire), was supported by this pilot research. Future research will help identify ways in which the Colorado Firemoth could be a useful indicator for forest managers in monitoring the success of efforts to restore a more historically natural forest ecosystem in the Front Range, and thereby reduce the risk of historically unnatural and destructive wildfires. A better understanding of the ecology and population dynamics of the Colorado Firemoth may also provide insights relevant to the management and recovery of endangered species such as the Pawnee Montane Skipper and Préble's Meadow Jumping Mouse, whose habitats are also created or maintained by the historically natural fire regime of the Colorado Front Range.

Methods

More than 30 fires that had burned within the past fifteen years in the Colorado Front Range were identified from records of the Pike and Arapahoe-Roosevelt National Forests and from personal communication with knowledgeable individuals. Some of these were wildfires and some were prescribed fires. The locations of these fires were mapped, and ten sites were visited between July 1 and July 12 (Table 1). The sites visited were all between 5,000 and 9,000 feet in elevation, within the zone where *Gaillardia aristata*, Blanketflower, can be found. Each site was surveyed for the presence of *G. aristata*, and also for adults or larvae of *Schinia masoni*, the Colorado Firemoth. Four sites were selected for data collection. At each of these sites a 100 meter transect was laid out with a forestry tape on a straight compass line in the burned area where *G. aristata* was present. The number of *G. aristata* blossoms at any stage of blooming (from bud to seedhead) was recorded meter by meter along the transect, within a distance of three meters on each side of the tape. At the same time, the number of blossoms containing larvae of *S. masoni* was recorded. Blossoms containing larvae are easily identified by the characteristic damage that larvae cause. A GPS unit was used, and the position and elevation of the beginning, end, and 50 meter mark of each transect was recorded. At each of the four sites a "control" transect was set up in an adjacent unburned (Black Tiger and Walker Ranch sites) or lightly-burned (Bobcat Gulch and Dadd-Bennett sites) area adjacent to the burn. Care was taken to select a location for the control transect that was as equivalent as possible in slope, aspect, and tree density and species composition. In the lightly-burned control sites at Bobcat Gulch and

Dadd-Bennett, no trees had been killed by the fire, even small ones, whereas in all the burned areas between 50 and 100% of the trees had been killed. Locations of all transects were plotted on topographic maps. Photographs were taken to document all transects, as well as other salient observations both at study sites and the other non-transect sites visited.

Table 1. Burn Sites Visited

Name/Location	Date	Type
Black Tiger*	1989	wildfire
Bobcat Gulch*	2000	wildfire
Buffalo Creek	1996	wildfire
Crosier Mountain	1998	prescribed
Dadd-Bennett*	2001	prescribed
High Meadows	2000	wildfire
Jamestown	1997 (?)	prescribed
Snowtop	1993	wildfire
Walker Ranch*	2000	wildfire
Winigar Ridge	1997	prescribed

* transects/data collected

Results

The data collected at the four sites are summarized in Table 2, and raw data for each transect can be found in Appendix 1. Blanketflowers can be quite abundant in burned areas, with densities up to approximately three blossoms per square meter only two years after a fire. Blanketflower populations decline after a burn, so that in areas not recently burned this plant is a negligible component of the understory community, if not entirely absent. In the area burned by the Black Tiger fire thirteen years ago, however, *G. aristata* still persists in significant numbers, although its abundance is dramatically lower than in recently burned areas. Firemoth larvae also can be abundant in the dense populations of Blanketflowers found in recently burned areas – at Bobcat Gulch, for example, almost 17% of the blossoms had moth larvae, an average of one moth larva in each two square meters. No moth larvae were found at Dadd-Bennett, a site burned one year ago, despite a fairly dense population of their host flower. Moth populations appear to persist after fires even though populations of their host plant decline dramatically. Interestingly, the highest rate of larval damage found at any site was at the thirteen-year-old Black Tiger burn, where more than 20% of Blanketflower blossoms had Firemoth larvae.

Table 2. Abundance of Blanketflowers and Firemoth Larvae.

Fire/Location (elevation)	Time Since Fire	Blanketflower Abundance		Firemoth Abundance		
		blossoms/600 m2	/m2	larvae/600 m2	/m2	% blossoms w/
Dadd-Bennett (8100 feet)	1 year	687	1	0	0	0
	50+ years (?)	0	0	0	0	0
Bobcat Gulch (7400 feet)	2 years	1,916	3	316	0.5	16.5
	lightly burned 2 years ago	127	0.2	11	0.02	8.7
Walker Ranch (7200 feet)	2 years	626	1	57	0.1	9.1
	50+ years (?)	0	0	0	0	0
Black Tiger (8700 feet)	13 years	73	0.1	16	0.03	21.9
	50+ years (?)	2	0.003	0	0	0

Discussion

The results from the four study sites clearly demonstrate the dramatic release of *Gaillardia aristata* by fire. This is clearly an early-successional species that loves intense fires that kill all trees. Within one year of a burn its populations explode and it becomes a dominant component of the understory. This pattern suggests that Blanketflower seeds may sprout from a soil seed bank until stimulated to germinate by the conditions following a fire, although it is also possible that they rapidly and massively are dispersed into burned areas within one year by an as yet unknown mechanism of dispersal. *Gaillardia aristata* persists at reasonable densities for at least 13 years after a fire, but virtually disappears within perhaps 30 to 50 years. Further research is needed to determine the disappearance curve of this plant.

The data show that abundance of *G. aristata* can vary greatly between sites of the same age since a fire. Soil type may be a factor in this variability. One piece of evidence that points toward an edaphic sensitivity is that Blanketflower is relatively uncommon on course, dry Pikes Peak Granite soils. Further research can help us understand the importance of such edaphic factors.

Serendipitous observations made while carrying out this research show that mechanical disturbance of the soil also creates the conditions needed by *G. aristata*. Construction at a site near the Bobcat Gulch burn – probably a bulldozer scraping away the vegetation from the soil surface -- had resulted in a dense population of Blanketflowers in an area of about 300 square meters. One adult Firemoth and numerous larvae were observed at this site in early July. At the site of pipeline construction along Cold Spring Road north of Nederland in Boulder County, *G. aristata* were abundant along the edges of the pipeline cut. Firemoth larvae were common at this site, which is about 5-10 miles from the Black Tiger burn. This reinforces the conclusion that *G. aristata* is a disturbance-dependent, early successional plant, which requires disturbance to eliminating competitors or change the conditions for germination of its seeds.

Results from this pilot study also demonstrate that *Schinia masoni* can colonize *G. aristata* populations within two years following a fire. No moths or larvae were found at the Dadd-Bennett burn site, despite a suitable population of Blanketflower. This may be because colonizing adult moths have not located this relatively small site yet. This may be because the nearest burn site less than about fifteen years old, with a dense enough population of Firemoths to provide a base of colonists, is too far away for adults to easily fly that far or find it. Data from the Black Tiger burn site show that Firemoths persist at significant densities even as *G. aristata* populations decline dramatically over fifteen years following a fire, providing a core population for colonizing the dense Blankeflower populations that develop at nearby burns. Because *G. aristata* virtually disappears from the understory community within an estimated 30 to 50 years after a fire, Firemoths must eventually disperse and colonize new burned areas to persist in the landscape. Like many species that live in early-successional communities, these moths may exist as a metapopulation -- that is, a "shifting mosaic of temporary populations linked by some degree of migration" (Primack 2000). Total populations of both *G. aristata* and *S. masoni* at the study sites are estimated in Table 3 by extrapolating the measured population densities.

Table 3. Estimated Firemoth abundance at the study sites.

Fire/Location	Area Burned (acres)	Year	Blanketflower Blossoms		Firemoth Larvae	
			per acre	total burn*	per acre	total burn*
Dadd-Bennett	unknown	2001	4,613	-----	0	-----
Bobcat Gulch	10,599	2000	12,910	137 million	2,131	22 million
Walker Ranch	1,084	2000	4,209	4.5 million	384	416,000
Black Tiger	1,804	1989	485	875,000	108	195,000

* extrapolated estimates, measured density X burned area at each site

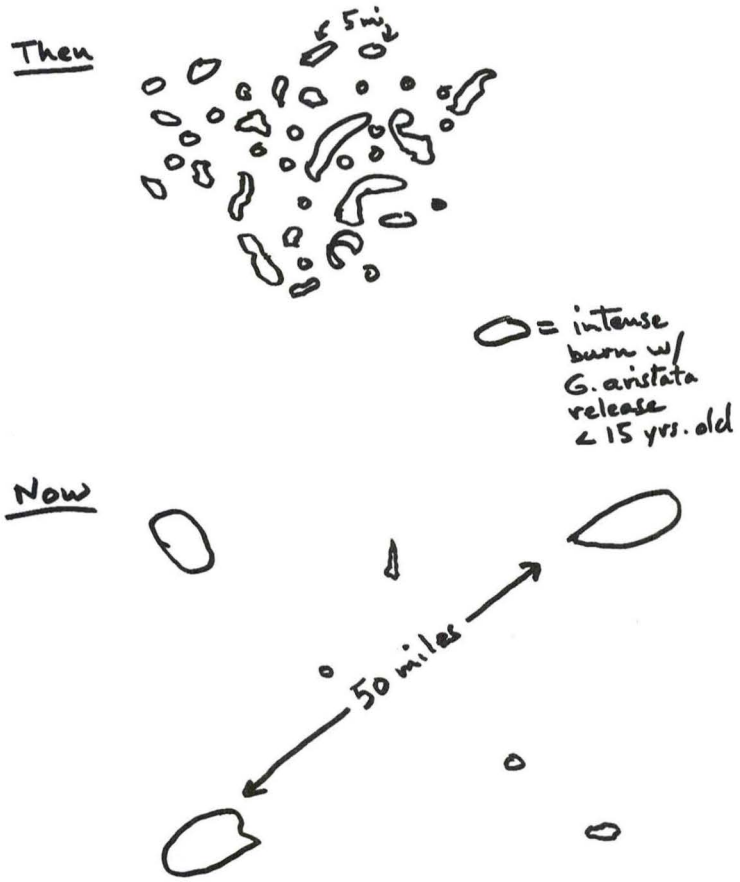
Table 3 indicates that the Firemoth population at the thirteen year old Black Tiger burn is probably quite viable – it is estimated at 195,000 moths, a population approximately one half as large as at the two year old Walker Ranch burn. This suggests that the sites of older burns may still be able to provide the Firemoth metapopulation with a "core" from which to colonize newly burned areas nearby. For example, the population of *G. aristata* released by the mechanical disturbance of the construction of the Cold Spring Road pipeline, only 3.7 miles away from the Black Tiger burn, and is infested by a very high level of Firemoth larvae. At the pipeline site 101/242 blossoms examined, or about 42%, had moth larvae, the highest level of damage observed at any site. We can speculate that the high abundance of moth larvae at the pipeline site may be explained by colonization of these Blanketflowers by adult moths flying from the Black Tiger burn site.

These results lead to the following researchable questions:

- how far can, and do, *S. masoni* adults fly to find new *G. aristata* populations?
- how does the size of a burn, and its population of *G. aristata,* affect the potential of moths to find and or successfully colonize it?

Could Firemoth abundance be an indicator of a more historically natural forest landscape in the Colorado Front Range? The answer to this question could prove useful to forest managers attempting to reduce the risk of catastrophic wildfires by restoring a more historically natural – and fire resistant – forest landscape. In historic fire regime, 2.5% or 100,000 acres burned per year on average. Openings of 1-100 acres were created by patchy crown fire in a mixed-intensity fire regime. (Kaufmann 2002; Kaufmann et al. 2000) In this kind of historically natural fire regime, the total area of hotly-burned patches (and thus of *G. aristata* release) must have been much larger than at present, and the average size of those patches was much smaller. This means that patches of *G. aristata* that – so they were much closer together. Figure 1 compares the spatial arrangement of the historical and present forest landscapes from a Firesmoth's perspective (distances between areas burned within the past fifteen years are hypothetical/rough estimates). In such a landscape the Colorado Firemoth would probably have been much more abundant than now, when it is rather rare except in recently burned habitats.

Figure 1. Comparing Present and Historical Forest Landscapes from a Firemoth's Perspective.



Conclusion

The results of the 2002 pilot research described above support the hypothesis that *Schinia masoni* is a rather sensitive indictor of the patchiness of the forest landscape in the Colorado Front Range, and the degree of departure of the current forest landscape from historically natural conditions – and thus also a sensitive indicator of the propensity of an area to burn with unnaturally high intensity over unnaturally large areas. *Schinia masoni*'s dependence on fire that this research clearly demonstrates is surely the result of a long evolutionary history: the ecology and life history of this moth are apparently an adaptation to the natural fire regime of Colorado Front Range ponderosa pine forests, to which it is endemic. I propose, therefore, that *Schinia masoni* – which like most heliothidine flower moths has no common name – be called the Colorado Firemoth. When this moth is rare, Colorado beware! -- because its rarity indicates that Front Range ponderosa pine forests are dense, with very few openings created by recent fires, and are therefore at risk of unnaturally large, unnaturally hot/high-intensity wildfires.

Next Steps/Further Research

The following tasks would build upon the knowledge gained in the 2002 pilot study summarized above, and lead to a better understanding of how the Colorado Firemoth could be a useful indicator for forest managers in monitoring the success of efforts to restore a more historically natural forest ecosystem in the Front Range, and thereby reduce the risk of historically unnatural and destructive wildfires:

1) resurvey burned-area transects at Black Tiger, Bobcat Gulch, Dadd-Bennett, and Walker Ranch Burns to detect trends in abundance of flowers and moths;
2) visit the Hayman burn (2002), especially the Cheesman Reservoir area, to survey for *G. aristata* and Firemoths;
3) visit the Big Elk Meadows burn (2002) to survey for *G. aristata* and Firemoths;
4) scout sites in the High Meadows burn on both granitic and finer, non-granitic soils to learn about edaphic factors affecting *G. aristata* and Firemoths;
5) conduct pilot studies to determine whether *G. aristata* is released from seeds in a soil seed bank following a fire, or whether seed dispersal from outside the burned area by some unknown mechanism is responsible for the extremely rapid increase in Blanketflowers;
6) estimate and/or model the distances between burned patches less than fifteen years old in the historically natural landscape and the current landscape to confirm the hypothesis that Firemoths must now disperse over much greater distances in order to colonize the Blanketflower populations released by fires.

Funding will be sought to carry out these tasks during the summer of 2003.

Acknowledgements

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Appendix 1: Transect Data

Black Tiger/Sugarloaf Mountain Burned Area 7/23/02

Blossoms (Larvae) East	Meter	Blossoms (Larvae) West		Blossoms (Larvae) East	Meter	Blossoms (Larvae) West
0	0-1	0		0	50-51	0
0	1-2	0		0	51-52	0
0	2-3	0		0	52-53	0
0	3-4	2 (1)		0	53-54	0
2 (0)	4-5	4 (1)		0	54-55	0
2 (0)	5-6	3 (0)		0	55-56	0
0	6-7	7 (0)		0	56-57	0
2 (2)	7-8	0		0	57-58	0
0	8-9	0		0	58-59	0
0	9-10	0		0	59-60	0
0	10-11	0		2 (0)	60-61	0
0	11-12	0		0	61-62	0
0	12-13	0		0	62-63	0
0	13-14	0		0	63-64	0
0	14-15	0		0	64-65	0
0	15-16	0		0	65-66	0
0	16-17	0		0	66-67	0
0	17-18	0		0	67-68	0
0	18-19	0		0	68-69	0
0	19-20	0		0	69-70	0
0	20-21	0		0	70-71	0
0	21-22	0		0	71-72	0
0	22-23	0		0	72-73	0
0	23-24	0		0	73-74	0
0	24-25	2 (0)		0	74-75	0
1 (0)	25-26	3 (0)		0	75-76	0
0	26-27	0		0	76-77	0
0	27-28	7 (4)		0	77-78	0
0	28-29	7 (4)		0	78-79	0
0	29-30	0		0	79-80	0
0	30-31	0		0	80-81	0
0	31-32	0		4 (2)	81-82	1 (0)
0	32-33	1 (0)		0	82-83	0
0	33-34	0		0	83-84	0
0	34-35	0		0	84-85	0
0	35-36	0		0	85-86	2 (1)
0	36-37	1 (0)		0	86-87	0
0	37-38	0		0	87-88	0
0	38-39	0		0	88-89	0
3 (0)	39-40	2 (0)		0	89-90	2 (0)
0	40-41	0		0	90-91	1 (0)
0	41-42	0		0	91-92	0
0	42-43	0		0	92-93	0
0	43-44	0		0	93-94	0
0	44-45	3 (1)		1 (0)	94-95	0
4 (0)	45-46	0		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	0
0	48-49	4 (0)		0	98-99	0
0	49-50	0		0	99-100	0

Transect Location and Date

Black Tiger/Sugarloaf Mountain Unburned Area 7/26/02

Blossoms (Larvae) East	Meter	Blossoms (Larvae) West		Blossoms (Larvae) East	Meter	Blossoms (Larvae) West
0	0-1	0		0	50-51	0
0	1-2	0		0	51-52	0
0	2-3	0		0	52-53	0
0	3-4	0		0	53-54	0
0	4-5	0		0	54-55	0
0	5-6	0		0	55-56	0
0	6-7	0		0	56-57	0
0	7-8	0		0	57-58	0
0	8-9	0		0	58-59	0
0	9-10	0		0	59-60	0
0	10-11	0		0	60-61	0
0	11-12	0		0	61-62	0
0	12-13	0		0	62-63	0
0	13-14	0		0	63-64	0
0	14-15	0		0	64-65	0
0	15-16	0		0	65-66	0
0	16-17	0		0	66-67	0
0	17-18	0		0	67-68	0
0	18-19	0		0	68-69	0
0	19-20	0		0	69-70	0
0	20-21	0		0	70-71	0
0	21-22	0		0	71-72	0
0	22-23	0		0	72-73	0
0	23-24	0		0	73-74	0
0	24-25	0		0	74-75	0
0	25-26	0		0	75-76	0
0	26-27	0		0	76-77	0
0	27-28	0		0	77-78	0
0	28-29	0		0	78-79	0
0	29-30	0		0	79-80	0
0	30-31	0		0	80-81	0
0	31-32	0		0	81-82	0
0	32-33	0		0	82-83	0
0	33-34	0		0	83-84	0
0	34-35	0		0	84-85	0
0	35-36	0		0	85-86	0
0	36-37	0		0	86-87	2 (0)
0	37-38	0		0	87-88	0
0	38-39	0		0	88-89	0
0	39-40	0		0	89-90	0
0	40-41	0		0	90-91	0
0	41-42	0		0	91-92	0
0	42-43	0		0	92-93	0
0	43-44	0		0	93-94	0
0	44-45	0		0	94-95	0
0	45-46	0		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	0
0	48-49	0		0	98-99	0
0	49-50	0		0	99-100	0

Transect Location and Date
Bobcat Gulch Burned Area – 7/13/02

Blossoms (Larvae) South	Meter	Blossoms (Larvae) North		Blossoms (Larvae) South	Meter	Blossoms (Larvae) North
0	0-1	0		10 (0)	50-51	34 (5)
0	1-2	0		0	51-52	15 (2)
0	2-3	0		0	52-53	27 (0)
0	3-4	0		9 (0)	53-54	10 (0)
0	4-5	0		2 (0)	54-55	21 (1)
0	5-6	7 (2)		0	55-56	0
0	6-7	10 (1)		0	56-57	0
0	7-8	83 (6)		0	57-58	0
0	8-9	4 (0)		0	58-59	0
0	9-10	0		0	59-60	0
4 (0)	10-11	0		0	60-61	0
0	11-12	0		24 (0)	61-62	0
0	12-13	0		16 (1)	62-63	0
0	13-14	0		80 (13)	63-64	0
14 (3)	14-15	0		0	64-65	5 (0)
30 (0)	15-16	0		0	65-66	0
0	16-17	0		0	66-67	0
0	17-18	0		0	67-68	0
0	18-19	0		0	68-69	0
0	19-20	26 (0)		18 (5)	69-70	0
0	20-21	0		34 (10)	70-71	0
0	21-22	0		0	71-72	0
0	22-23	0		21 (1)	72-73	0
0	23-24	0		0	73-74	0
0	24-25	0		8 (3)	74-75	14 (1)
0	25-26	0		14 (1)	75-76	40 (3)
0	26-27	0		105 (3)	76-77	84 (4)
0	27-28	0		66 (27)	77-78	64 (14)
0	28-29	0		27 (4)	78-79	2 (0)
0	29-30	0		28 (3)	79-80	25 (0)
0	30-31	0		0	80-81	0
0	31-32	0		0	81-82	0
0	32-33	0		0	82-83	36 (5)
0	33-34	0		116 (22)	83-84	67 (15)
102 (14)	34-35	0		40 (6)	84-85	46 (5)
11 (0)	35-36	0		0	85-86	8 (0)
68 (8)	36-37	0		23 (5)	86-87	50 (17)
14 (0)	37-38	0		20 (11)	87-88	33 (14)
56 (5)	38-39	2 (0)		2 (0)	88-89	0
9 (1)	39-40	17 (4)		45 (25)	89-90	7 (5)
0	40-41	12 (0)		27 (22)	90-91	0
56 (8)	41-42	5 (0)		0	91-92	0
26 (1)	42-43	16 (8)		0	92-93	0
0	43-44	6 (0)		0	93-94	0
0	44-45	0		0	94-95	0
0	45-46	10 (3)		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	0
1 (0)	48-49	0		0	98-99	0
3 (0)	49-50	19 (4)		0	99-100	0

Transect Location and Date
Bobcat Gulch Unburned/Lightly-Burned Area 7/13/02

Blossoms (Larvae) South	Meter	Blossoms (Larvae) North		Blossoms (Larvae) South	Meter	Blossoms (Larvae) North
0	0-1	0		0	50-51	0
0	1-2	1 (0)		0	51-52	0
0	2-3	0		0	52-53	0
0	3-4	5 (4)		2 (0)	53-54	0
1 (0)	4-5	1 (0)		4 (0)	54-55	0
0	5-6	8 (0)		0	55-56	0
0	6-7	0		0	56-57	0
0	7-8	0		0	57-58	9 (4)
0	8-9	0		0	58-59	7 (0)
0	9-10	0		0	59-60	5 (1)
0	10-11	0		0	60-61	5 (0)
0	11-12	0		0	61-62	0
0	12-13	0		0	62-63	0
0	13-14	0		0	63-64	0
0	14-15	1 (0)		0	64-65	0
3 (0)	15-16	0		0	65-66	0
0	16-17	5 (0)		0	66-67	11 (0)
0	17-18	0		0	67-68	1 (0)
0	18-19	0		0	68-69	0
0	19-20	2 (0)		0	69-70	0
0	20-21	0		0	70-71	0
0	21-22	0		0	71-72	0
0	22-23	1 (0)		0	72-73	0
0	23-24	0		0	73-74	0
0	24-25	7 (0)		0	74-75	0
2 (0)	25-26	1 (0)		0	75-76	0
5 (0)	26-27	0		0	76-77	0
0	27-28	0		0	77-78	0
1 (0)	28-29	0		0	78-79	0
0	29-30	5 (0)		0	79-80	0
0	30-31	1 (0)		0	80-81	0
0	31-32	2 (0)		0	81-82	0
0	32-33	0		0	82-83	0
0	33-34	0		0	83-84	0
7 (2)	34-35	2 (0)		0	84-85	0
2 (0)	35-36	0		0	85-86	0
4 (0)	36-37	0		0	86-87	0
0	37-38	5 (0)		0	87-88	0
2 (0)	38-39	0		0	88-89	0
0	39-40	0		0	89-90	0
0	40-41	1 (0)		0	90-91	0
0	41-42	0		0	91-92	0
0	42-43	3 (0)		0	92-93	0
0	43-44	3 (0)		0	93-94	0
0	44-45	0		0	94-95	0
0	45-46	2 (0)		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	0
0	48-49	0		0	98-99	0
0	49-50	0		0	99-100	0

Transect Location and Date
Dadd-Bennett (Prescribed) Burned Area 7/12/02

Blossoms (Larvae) South	Meter	Blossoms (Larvae) North		Blossoms (Larvae) South	Meter	Blossoms (Larvae) North
0	0-1	0		0	50-51	3
0	1-2	0		0	51-52	0
0	2-3	0		0	52-53	0
0	3-4	0		0	53-54	0
0	4-5	0		2	54-55	0
0	5-6	0		13	55-56	0
0	6-7	0		0	56-57	0
0	7-8	0		0	57-58	0
0	8-9	0		0	58-59	0
0	9-10	0		0	59-60	0
0	10-11	0		8	60-61	30
0	11-12	0		22	61-62	28
0	12-13	0		0	62-63	5
11	13-14	0		0	63-64	0
14	14-15	0		0	64-65	0
43	15-16	0		0	65-66	0
62	16-17	0		0	66-67	0
101	17-18	0		0	67-68	0
0	18-19	0		0	68-69	0
0	19-20	0		0	69-70	0
30	20-21	0		1	70-71	0
44	21-22	14		1	71-72	0
8	22-23	33		0	72-73	0
4	23-24	7		0	73-74	0
0	24-25	16		0	74-75	0
0	25-26	3		0	75-76	0
0	26-27	9		0	76-77	1
9	27-28	3		0	77-78	0
25	28-29	0		0	78-79	1
17	29-30	0		0	79-80	0
0	30-31	0		0	80-81	0
1	31-32	0		0	81-82	0
0	32-33	0		0	82-83	0
0	33-34	0		0	83-84	0
0	34-35	0		0	84-85	0
0	35-36	0		0	85-86	0
0	36-37	0		0	86-87	0
0	37-38	0		0	87-88	0
0	38-39	0		0	88-89	0
0	39-40	0		0	89-90	0
0	40-41	0		0	90-91	0
11	41-42	0		0	91-92	0
14	42-43	0		0	92-93	0
27	43-44	0		0	93-94	0
22	44-45	11		0	94-95	0
12	45-46	0		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	0
15	48-49	0		0	98-99	0
6	49-50	0		0	99-100	0

Transect Location and Date
Walker Ranch/Eldorado 7/16/02

Blossoms (Larvae) South	Meter	Blossoms (Larvae) North		Blossoms (Larvae) South	Meter	Blossoms (Larvae) North
0	0-1	0		0	50-51	0
0	1-2	0		0	51-52	0
0	2-3	0		0	52-53	0
0	3-4	0		0	53-54	0
0	4-5	0		0	54-55	0
0	5-6	0		0	55-56	0
0	6-7	0		0	56-57	0
0	7-8	0		0	57-58	0
0	8-9	2 (0)		0	58-59	0
0	9-10	9 (0)		0	59-60	0
0	10-11	19 (0)		0	60-61	0
0	11-12	14 (4)		0	61-62	0
0	12-13	41 (0)		0	62-63	0
14 (0)	13-14	77 (4)		0	63-64	0
11 (0)	14-15	0		0	64-65	0
0	15-16	15 (0)		1 (0)	65-66	0
25 (0)	16-17	0		1 (0)	66-67	0
9 (1)	17-18	4 (0)		0	67-68	1 (0)
0	18-19	0		0	68-69	0
0	19-20	155 (5)		2 (0)	69-70	0
0	20-21	13 (0)		0	70-71	0
11 (4)	21-22	17 (0)		0	71-72	0
5 (0)	22-23	20 (2)		0	72-73	0
4 (0)	23-24	5 (0)		0	73-74	0
0	24-25	15 (2)		0	74-75	0
0	25-26	0		0	75-76	0
0	26-27	0		0	76-77	0
0	27-28	0		0	77-78	0
0	28-29	0		5 (0)	78-79	5 (4)
0	29-30	0		52 (5)	79-80	20 (5)
0	30-31	0		0	80-81	12 (0)
0	31-32	0		3 (3)	81-82	0
0	32-33	0		0	82-83	0
0	33-34	0		0	83-84	0
0	34-35	0		0	84-85	0
0	35-36	0		0	85-86	0
0	36-37	0		0	86-87	0
0	37-38	0		0	87-88	0
0	38-39	0		0	88-89	0
0	39-40	0		0	89-90	0
0	40-41	0		0	90-91	0
0	41-42	0		3 (3)	91-92	0
0	42-43	0		0	92-93	0
0	43-44	0		0	93-94	0
0	44-45	0		0	94-95	0
9 (0)	45-46	0		0	95-96	0
0	46-47	0		0	96-97	0
0	47-48	0		0	97-98	19 (10)
0	48-49	7 (0)		0	98-99	0
0	49-50	0		19 (5)	99-100	0